May, 2000

STATE OF CALIFORNIA

Department of Transportation
[1]Specification #PT-150VOC(A)

**Paint, Acetone-Based/VOC-Compliant, Traffic Line,
White, Yellow and Black**

1.0 SCOPE This Specification covers a ready to use, acrylic, one-component, solvent-borne, acetone-based/VOC-compliant traffic line paint intended for application to either asphaltic or portland cement concrete pavements.

2.0 SPECIFICATIONS AND STANDARDS The following Specifications, Test Methods, and Standards in effect on the opening date of the Invitation for Bid form a part of this Specification where referenced.

- ASTM D476, ASTM D522, ASTM D562, ASTM D711, ASTM D713, ASTM D868, ASTM D869, ASTM D969, ASTM D1210, ASTM D1475, ASTM D1640, ASTM D2369, ASTM D2372, ASTM D2486, ASTM D2698, ASTM D3186, ASTM D3335, ASTM D3718, and ASTM G53.
- Federal Specification 595b, Color #33538 and #37038.
- Code of Federal Regulations, Title 49.
- California Department of Transportation, Test Method No. 660.
- California Department of Transportation, Standard Specifications, July, 1999.
- California Air Resources Board publication: “Suggested Control Measure for Architectural Coatings”.

3.0 REQUIREMENTS

3.1 General: This Specification is intended to specify traffic paint that will meet pavement delineation requirements for highway construction and maintenance. This traffic paint is to be used in conjunction with glass spheres to produce delineation visible during both day and night conditions.

3.2 Composition:

3.2.1 Acrylic Copolymer Resin

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1 This specification cancels and supercedes specification #PT-150VOC (May, 1999).

The paint binder shall consist of either of the two acrylic copolymer resins described below, or a combination of the two resins.

- Poly (methyl methacrylate/n-butyl methacrylate/methacrylic acid) copolymer, or
- Poly (n-butyl methacrylate/diethyl aminoethyl methacrylate) copolymer.

These resins shall have the following characteristics:

Appearance	white, non-dusting beads
%Nonvolatile	98% min.
Average Molecular Weight	60000
Glass Transition Temperature	50°C min.
Gardner Bubble Viscosity (40% sol'n. in toluene)	L to O
Gardner Color (20% sol'n. in toluene)	2 max.

3.2.2 Solvents

The primary solvent shall be acetone. The paint may contain smaller amounts of other solvents so long as the VOC requirements in section 3.3.13 are met.

3.2.3 Pigments

The white paint shall contain a minimum of 0.12 kg per liter of titanium dioxide pigment meeting ASTM D476 Type II (Rutile).

The yellow paint shall be pigmented with Pigment Yellow C.I. #65, Pigment Yellow C.I. #75 or Pigment Yellow C.I. #200. Other pigments may be added to meet the yellow color and opacity requirements in sections 3.3.19 and 3.3.16, respectively. However, the paint shall not contain lead, mercury, cadmium, chromium or other toxic heavy metals.

3.2.4 The remainder of the paint composition shall be determined by the manufacturer; within the constraints of the requirements below. It shall be the manufacturer's responsibility to produce a traffic paint containing the necessary solvents, plasticizers, dispersants, preservatives and all other additives, so that the paint will retain its viscosity, stability and all other properties as specified herein. No glass beads, sand or toxic heavy metals shall be permitted in the paint formulations.

3.3 Characteristics of the Finished Paint:

3.3.1 Condition in the Container

The paint, as received, shall show no evidence of biological growth, corrosion of the container, livering or hard settling. The paint shall be returned to a smooth and

homogeneous consistency which contains no; gel structures, persistent foam or air bubbles - using only hand mixing.

		White	Yellow	Black
3.3.2	Degree of Settling, minimum, ASTM D869	7	7	7

A 500 ml (1 pint) paint can is filled with a well mixed sample. The can is capped and allowed to set undisturbed at [2]standard conditions for 14 days. The settling is then determined as specified in ASTM D869. The 1 quart laboratory samples of each batch, when received, shall also pass this test.

		White	Yellow	Black
3.3.3	Density, g/mL, at 25°C, ASTM D1475	1.415 ±0.04	1.367 ±0.04	1.367 ±0.04
3.3.4	Nonvolatile Content, Weight %, ASTM D2369	72.2 ±2.0	71.5 ±2.0	71.5 ±2.0
3.3.5	Pigment, Weight %, ASTM D2698	54.6 ±2.0	53.3 ±2.0	53.3 ±2.0
3.3.6	Nonvolatile in Vehicle, Weight %, minimum, ASTM D2369 and ASTM D2372.	37	37	37

Centrifuge a well-mixed sample as per ASTM D2372 until the pigment separates, leaving a clear resin solution at the top of the centrifuge tube. Determine the % nonvolatile of this clear layer using ASTM D2369.

		White	Yellow	Black
3.3.7	Infrared Spectra of Nonvolatile Vehicle, ASTM D3168, allowable variation from laboratory reference	None	None	None
3.3.8	Consistency, K.U. at 25 ±1°C, ASTM D562	70-88	70-88	70-88
3.3.9	Accelerated Package Stability	Pass	Pass	Pass

[2] Standard conditions are defined here as: 23±2°C and 50±5% relative humidity.

Fill a clean 500 mL (1 pint) resin-lined friction-top paint can with a well-stirred sample. Immediately close the can tightly. Store this can at a temperature of 40ºC for 14 days. Allow the can to cool overnight. Determine the Consistency of the paint as in section 3.3.8, except allow hand stirring for 5 minutes to ensure uniform redistribution of any settlement. The Consistency of the paint shall not change more than 5 K.U. from the initial value after this heated storage period. Draw down a 330µm thick wet film of this heat-aged sample on a glass plate and examine for Appearance as in 3.3.15.

	White	Yellow	Black
3.3.10 Fineness of Dispersion, Hegman, minimum, ASTM D1210	3.0	3.0	3.0

	White	Yellow	Black
3.3.11 Dry to No Pick-Up Time, without beads, minutes, maximum, ASTM D711	10	10	10

	White	Yellow	Black
3.3.12 Dry through, minutes, maximum, ASTM D1640	20	20	20

This test may be performed on the same draw down sample as in section 3.3.11. The test is the same as outlined in ASTM D1640 except that the lightest thumb pressure possible should be used. The thumb is rotated through an angle of 90 degrees while lightly in contact with the film. The drying time at which this rotation does not break the film is recorded.

	White	Yellow	Black
3.3.13 Volatile Organic Compounds (VOC), grams per liter of paint, excluding acetone and other exempt solvents, maximum.	150	150	150

Determine the VOC using the methods listed in the California Air Resources Board publication titled “Suggested Control Measure for Architectural Coatings”.

	White	Yellow	Black
3.3.14 Flexibility, ASTM D522, (Method B)	Pass	Pass	Pass

Use 100x150 mm tin-plated steel panels 250µm thick. Prepare the panel by lightly buffing one side with Grade 0 (medium-fine) steel wool, followed by cleaning with toluene and drying. Draw down the paint on the buffed side of the panel to a wet film thickness of 130µm. Air dry the panel for 24 hours at standard conditions, then bake for 5 hours at 105±2°C and finally condition the panel for 30 minutes at standard conditions. Bend the panel 180° over a 13 mm mandrel and examine under a magnification of 10 diameters. The paint film shall not crack, chip or flake when the panel is bent around the mandrel.

	White	Yellow	Black
3.3.15 Appearance	Pass	Pass	Pass

Draw down a 330µm thick wet film of the paint on a glass plate and allow to dry for 24 hours at standard conditions. The paint shall produce a film that is smooth, uniform, free from; grit, undispersed particles, craters, pinholes and cracking.

	White	Yellow	Black
3.3.16 Dry Opacity, minimum	0.92	0.85	1.0

On a black-white Leneta chart (Form 2C-Opacity), draw down a 130µm thick wet film of paint covering both the black and white portions of the chart. Dry for 24 hours at standard conditions. Measure the diffuse reflectance of the sample using a Photovolt Reflection Meter, Model 670 or equivalent, with Model 610 T Search Unit provided with Tristimulus filters; green, blue and amber. Calibrate according to the manufacturer's instructions and measure the reflectance of the paint, over the white and black portions of the chart, while using the green filter. Dry Opacity is calculated as:

$$\text{Dry Opacity} = \frac{\text{Reflectance over black}}{\text{Reflectance over white}}$$

	White	Yellow	Black
3.3.17 Yellowness Index, maximum	10	-	-

Draw down a 330µm thick wet film on two 75x150 mm chromate treated aluminum panels. Dry for 24 hours at standard conditions. Save one panel for the Accelerated Weathering test (section 3.3.21). Using a Reflection Meter (see section 3.3.16), measure the reflectance of the white paint film using the green, blue and amber tristimulus filters. Follow the manufacturer's instructions to recalibrate the Reflection Meter as the filters are changed. Calculate the Yellowness Index as follows:

$$\text{Yellowness Index} = \frac{\text{Amber - Blue}}{\text{Green}} \times 100$$

	White	Yellow	Black
3.3.18 Daylight Luminous Reflectance	84 min.	48-60	<5

With the same draw down as in section 3.3.17 above, measure the reflectance of the white and yellow paint films using the Reflection Meter and the green tristimulus filter.

3.3.19 Yellow Color

Draw down the yellow paint on two chromate treated aluminum panels as described in section 3.3.17. One panel should be used for the Accelerated Weathering

test (section 3.3.21). Retain the other yellow panel as a control and for the Reflectance test (section 3.3.18). The yellow color shall match Federal Standard 595b, color #33538 and shall lie within the chromaticity coordinate limits as defined below when tested according to California Test Method No. 660 and plotted on a C.I.E. (1931) Chromaticity Diagram. The yellow color shall lie within a "box" defined by plotting the following four (x,y) pairs on the C.I.E. Chromaticity Diagram (1931).

(x1,y1) = (0.5125, 0.4866)
(x2,y2) = (0.4733, 0.4533)
(x3,y3) = (0.4848, 0.4305)
(x4,y4) = (0.5348, 0.4646)

Measurement conditions: 2º/Illuminant "C"
Hue: 580 to 583.5 nm
Brightness: Y=48 to 60

3.3.20 Black Color

Draw down the black paint on a chromate treated aluminum panel as described in section 3.3.17. After drying for 24 hours at standard conditions the color shall closely match Federal Standard 595b, color #37038.

3.3.21 Accelerated Weathering Test
Ultraviolet Light and Condensate Exposure, 300 hours total, ASTM G53.

Prepare samples of the white and yellow paints as described in section 3.3.17. Alternately expose the samples to four hours of UV exposure at 60°C, followed by four hours condensate exposure at 40°C. Type FS-40 (UV-B) bulbs are used at an irradiance level of 0.47 watts per square meter at 310 nm., as measured at the sample surface during the UV cycle. After 300 hours total exposure the paint samples shall meet the requirements below. Retain these samples for the Scrub Resistance test (see section 3.3.22).

White - Yellowness Index, maximum, 12 (see section 3.3.17).
Yellow - Yellow Color must lie within a chromaticity limits "box" defined by plotting the four (x,y) pairs below on a C.I.E. (1931) Chromaticity Diagram (see section 3.3.19 for more detail).

(x1,y1) = (0.5125, 0.4866)
(x2,y2) = (0.4690, 0.4498)
(x3,y3) = (0.4800, 0.4272)
(x4,y4) = (0.5348, 0.4646)

Measurement conditions: 2º/Illuminant "C"
Hue: 580 to 583.5 nm
Brightness: Y=48 to 60

	White	Yellow	Black
3.3.22 Scrub Resistance, cycles, minimum	500	500	500

Follow the procedure in ASTM D2486 modified to use the exposed 75x150 mm panels from the Accelerated Weathering test (section 3.3.21). Tape the aluminum sample panel to the scrub machine with its 75 mm length parallel to the axis of scrubbing and lying in the path of the oscillating scrub brush. No shim shall be used. The paint shall not wear through on any part of the paint film in less than 500 cycles.

	White	Yellow	Black
3.3.23 Degree of Bleeding, contrast ratio, minimum, ASTM D868, ASTM D969	0.95	0.95	-

Draw down a 330µm wet paint film on both; a piece of 15# / 100 sq. ft. asphalt-saturated roofing felt, and a Leneta chart (Form 2C - Opacity). Let the paint dry for 24 hours. Measure the reflectance of the paint on both the painted roofing felt and the white portion of the Leneta chart using the procedure in section 3.3.18. Calculate the contrast ratio as shown below.

$$\text{Contrast Ratio} = \frac{\text{Reflectance over painted asphalt-saturated roofing felt}}{\text{Reflectance over painted white portion of Leneta chart}}$$

	White	Yellow	Black
3.3.24 Roadway Service Durability Rating, minimum ASTM D713, after 180 days exposure	6	6	-

Test stripes shall be applied transversely across the pavement in accordance with ASTM D713. Paints shall be applied and tested on both portland cement concrete and asphalt concrete pavements.

The dry paint film thickness of the test stripes shall be between 170 and 250µm as determined from test panels taken during application. Current State Specification glass beads (moisture-proof type) shall be applied immediately after the paint and during the same striping operation. The paint film shall accept the glass beads so that the spheres are embedded into the film to a depth of 60% of their diameters. Test stripes will be observed for a period of 180 days from the date of application.

After 180 days of service, the durability of the test stripes will be rated from 0 to 10 in accordance with ASTM D713. Only those test stripes with a rating of 6 or better will be accepted. Glass beads shall have good retention in the test line. This is determined by close-up examination of the test line.

This Roadway Service Durability Rating may be waived or evaluated for a period of less than 180 days at the option of the Engineer.

		White	Yellow	Black
3.3.25	Lead, mg/kg in dried paint, maximum, ASTM D3335	100	100	100

		White	Yellow	Black
3.3.26	Chromium, mg/kg in dried paint, maximum, ASTM D3718	50	50	50

3.4 Workmanship:

3.4.1 The paint shall be free from foreign materials such as; dirt, sand, fibers, or other materials capable of clogging; screens, valves, pumps, or other equipment used in paint striping apparatus.

3.4.2 The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container and shall not become granular or curdled. Any settlement of the pigment in the paint shall result in a thoroughly wetted, soft mass, which permits the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed with a minimum of resistance to the sidewise manual motion of the paddle across the bottom of the container. This stirring shall return the paint to a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement or any other cause, then the paint shall be considered unfit for use.

3.4.3 The paint shall retain all specified properties under normal storage conditions for 12 months after acceptance and delivery. The vendor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The characteristics of any replacement paint, as specified in section 3.3, shall remain satisfactory for 12 months from the date of acceptance and delivery.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Inspection: A one-quart sample of each batch of traffic paint intended for use by the Department of Transportation must be sent to the Transportation Laboratory for testing and approval before the batch is shipped. A batch shall be that amount of paint which was manufactured and packaged in a single operation. A manufacturers' test report shall be included with the one-quart sample of each batch. The following information shall be included in the manufacturers' test report: Dry to No Pick-Up time, Dry Opacity, Yellowness Index, Reflectance, Consistency, Non-Volatile Weight Percent, Pigment Weight Percent and Density.

Once the Transportation Laboratory approves a batch of paint, the manufacturer will be notified that the batch is approved for shipment. Upon shipment of the approved

batch of paint, the manufacturer shall fax the following information to the Transportation Laboratory within 48 hours.

- A list of each delivery location.
- Name and phone number of contact person(s) at the delivery location(s).
- State Specification number (PT-150VOC(A)).
- Colors, batch numbers and quantity of each batch of paint delivered.

This information shall be faxed to: Transportation Laboratory, Chemical Testing Section, 5900 Folsom Blvd., Sacramento, CA 95819-0128, attn.: Lisa Dobeck, (916) 227-7280, Fax (916) 227-7168.

The Department of Transportation reserves the right to retest any batch of traffic paint after delivery. Data from such retesting shall prevail over all other tests and will be the basis of rejection. Material not meeting the specification shall be removed and replaced by the manufacturer at their expense, including all costs for handling, retesting and shipping.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging: All manufactured paint shall be prepared at the factory ready for application. The finished paint shall be furnished in the container size specified in the purchase order or contract.

When 19 liter containers are specified, they shall be round and have standard full open head and bail. If 208 liter steel drums are specified, they must have removable lids and airtight band fasteners.

When bulk containers are required by the purchase order or contract, the paint shall be delivered in a container (tote) meeting the following requirements.

1. Tank volumes are estimated and so specified in each of three (3) Bulk Container drawings dated 09-04-91. Vendor shall allow a 19 liter headspace for expansion of the paint.
2. Maximum size in regards to width, depth and height shall be in accordance with one of the three drawings dated 09-04-91.
3. Top openings; 46 cm diameter manhole and 15 cm diameter fill cap.
4. Bottom outlet; 5 cm I.D. full flow non-restrictive valve with outlet guard.
5. Outlet to have 'Ever-Tite' or compatible quick coupler.
6. Fabricated from 304 stainless steel.
7. Capable of being stacked two (2) high when full.
8. Capable of being lifted by crane (lifting eye) and forklift when full.
9. Top of tank shall be equipped with one (1) vacuum relief valve and one (1) pressure relief valve.
10. Top opening and outlet shall provide for easy installation of liner.

11. Proper certification by the California Highway Patrol that the container complies with all applicable laws, rules, and regulations.

All shipping containers must comply with Code of Federal Regulations, Title 49 and all other applicable Federal and State Regulations governing their use. The containers and lids must lined with a suitable coating so as to prevent attack by the paint or by agents in the airspace above the paint. The lining must not come off the container or lid as skins.

Containers shall be colored white, including lids, and have an identifying band of the appropriate color around and within the top one-third of the container. Stainless steel containers (totes) do not need to be painted white.

All containers shall be properly sealed with suitable gaskets and shall show no evidence of leakage and shall remain in satisfactory condition for a period of 12 months after delivery. The vendor shall be held responsible for replacing containers unfit for use and will be responsible for all costs and transportation charges incurred in replacing paint and containers.

All containers shall be palletized and banded for shipment.

5.2 Marking: All containers of paint shall be labeled showing the State Specification number, manufacturer's name, date of manufacture, color and manufacturer's batch number. Containers shall be clearly labeled "Acetone-Based/VOC-Compliant Traffic Paint".

All containers of the paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of California.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are; toxic, corrosive, flammable, etc., as outlined in the Code of Federal Regulations, Title 49.

The Contractor shall list on the Demountable Weight Tags the kilograms per liter and pounds per gallon each for the white, yellow and black paints.

6.0 NOTES

6.1 Certification of Compliance: The manufacturer shall furnish a Certificate of Compliance with each batch of paint, in accordance with the provisions of Section 6-1.07 of the Department of Transportation Standard Specifications, July, 1999.

6.2 Material Safety Data Sheets: The manufacturer shall furnish MSDS product information sheets whenever paint is delivered to a Department of Transportation facility.

6.3 Air Pollution Compliance: The paint shall comply with all air pollution control rules and regulations within the State of California in effect at the time the paint is manufactured.

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